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LASL EXPERIENCE IN DECONTAMINATION OF THE ENVIRONMENT

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ABSTRACT

Since 1972 the Los Alamos Scientific Laboratory (LASL) has been actively involved in land area surveys for radioactive contamination and has gained considerable experience in cleanup of lands considered to have unacceptable levels of radioactive contamination. This paper describes our experience and means of arriving at recommendations for ALARA.

INTRODUCTION

Starting in 1971 at the request of the Atomic Energy Commission (AEC), the Los Alamos Scientific Laboratory (LASL) has been actively engaged in radiological surveys of lands that were formerly utilized by the AEC or its predecessor agency, the Manhattan Engineer District. These lands were considered potentially to have radioactive contamination above those levels presently considered acceptable. Also, LASL is pursuing a vigorous program of environmental decontamination in conjunction with present decontamination and decommissioning (D & D) activities. In this discussion I will describe a major environmental decontamination project conducted at LASL in 1975-1976,[1] which is representative of how such work is presently conducted. This description will include methods and recommendations that grew from our experience.

HISTORY OF TA-1

The main technical area (TA-1) at Los Alamos was constructed in great haste during 1943-1944 to provide facilities for research and development (R & D) on nuclear fission weapons. The sense of urgency continued when it was decided that the United States should develop a nuclear fusion weapon. Major R & D for these programs was conducted at TA-1 in Los Alamos, which is pictured in this slide as it appeared in 1958. As you can see, a large number of crudely constructed buildings were tightly packed into a small land area. Radioactive materials including plutonium, uranium, and fission products were used here. The work resulted in varying degrees of radioactive contamination of some of the buildings, waste handling systems and land. Research was gradually moved to new and better facilities further away from the Los Alamos townsite during the 1950s. When vacated, the obsolete TA-1 facilities were decontaminated and removed or dismantled and placed in radioactive waste pits. Some soil was also removed to the disposal pits. In 1966 the land was given to Los Alamos county or released for sale to the public and became a major portion of downtown Los Alamos as indicated in this aerial view (Slide 2). A motel, gasoline stations and fast food restaurants dominated the area in 1976. Development is still very active in this area. This slide indicates the relative positioning of major buildings then and in 1975.

The land resurvey indicated significant (to 200 pCi/g) plutonium contamination in a gully below a septic tank outfall located on a canyon edge. The septic tank had at one time served the building that housed a laundry for contaminated clothing and safety equipment. While removing the septic tank in August 1975, a pocket of contamination (to 125 nCi/g) of early-1945 Hanford plutonium was discovered ~1.2 m below the surface. Also a pipe sherd with 4000 c/m alpha was found on the surface nearby. The discovery of contamination of this magnitude and contaminated surface fragments indicated considerably more exploration and possible decontamination were required.

The find of contamination was announced in a press release that made newspapers throughout the United States. After developing a plan of action, the proposed plans were presented to the land owners and press at a public meeting. After gaining landowner permission, the additional work began in September 1975.

METHODS

Historical Research

One of the most important pieces of early work was to do a thorough historical review of old drawings, documents, reports, memos and conduct interviews with old timers to determine what happened where and what contamination problems might exist. This was merely a starting place -- records from early days were not always correct, e.g., when removing the septic tank (right where it was identified to be) we expected to find a rectangular concrete tank full of dirt. We found a cylindrical metal tank full of sludge and water. One old memo (found later) indicated the tank was put in place after the laundry was moved elsewhere. There were many other such examples.

Using the historical data, environmental sampling was concentrated in areas of suspected contamination. However, an intensive survey throughout the area was also conducted. Also, prior to moving any soil, a detailed photographic survey was made to establish 'as found' conditions. The agreement was to return the area to the "as found" condition. Should there be any questions, the photographs could help substantiate how the area was found. A small chalkboard with identification, time and date of the scene was included in each photo to make it a legal document. This concept of the chalkboard was continued throughout the project and many photos were made for the record.

Environmental Survey Methods

A number of soil sampling schemes were employed in the TA-1 surveys. In the 1974 survey, random and historically interesting locations were surveyed by taking gross gamma measurements with a high pressure ionization chamber and a micro-R meter. Low-energy X-rays were monitored with a Fidler system coupled to a portable 6-channel pulse height analyzer. (SLIDE). Plug soil samples (7.6 cm diam. by 5.1 cm deep) were collected at the corners and center of a 10 m square and were composited to form a single sample representing that location. Depth distributions were measured at several locations by taking samples with 61 cm long 2.5 cm diam. PVC coring tubes.

In 1975 on, surface samples were scooped from chosen locations. In addition to PVC coring tubes, soil samples at depth were collected by taking cuttings from a portable gasoline-powered fence post auger. For deeper samples a truck mounted drill rig was used (SLIDE). Auger cuttings were the usual sample of choice. Core samples could also be taken if there was concern about zones of contamination below which specific information was required. However, auger drilling is $\sim$4 times faster than coring so sampling of auger cuttings was the usual method used with the drill rig. We found it useful to display depth information pictorally (SLIDE). In areas of known contamination, boundaries of contamination were evaluated by digging trenches with a backhoe (SLIDE). This offered a great deal of information for one could collect many samples at horizontal and vertical locations. Uniformity of contamination could also be evaluated. (Was the contamination at one location the same on the opposite trench wall?) Portable instrument surveys could be made of the trench walls and surfaces to monitor for hot spots that might be missed by soil sampling. Unanticipated finds are also possible. In this trench we intercepted a zone of contaminated asphalt that had been covered with earth. Nearby a contaminated janitor's brush was also found. Soil sampling results from the trenches could be pictorally represented in several ways (SLIDES), which was very useful in decision making.

Soil Analysis

Because most of the isotopes of concern were alpha emitters, which also give off low energy X-rays, two phoswich detectors (purchased for lung counting) were adapted for field use (SLIDE) because they had a background 2 - 3 times lower than that of the more commonly used FIDLER detectors.[2] The entire 40 acre area was surveyed in a close grid to locate hot spots that might have been overlooked in other surveys. When a suspicious count rate was identified, surveyors removed surface soil and continued to monitor to see if the count rate changed. If buried contamination were present, the count rate would go up. We were able to find a 15 kg piece of normal uranium buried ~0.6 m deep in this manner. (SLIDE) The phoswich has now evolved into a commercially available, completely portable instrument as was described earlier by John Umbarger.

(SLIDE) Soil samples were screened using a ZnS alpha scintillation system which had a nominal 20 pCi/g detection limit (3σ) for alpha contamination in soil.[2] Because this was a rapid technique, with reasonable detection sensitivity, it was used to direct exploration and decontamination efforts. Approximately 8000 samples were analyzed in this manner. Of course these results had to be backed up by definitive radiochemistry.

Decontamination Methods

Because the decontamination was very close to commercial businesses, we took extra precautions to minimize the spread of contamination, particularly by airborne pathways. Thus, dust suppression was a key element in our methods.

For known hot spots (e.g., at the end of contaminated discharge lines, etc.), which were usually rather limited in size, laborers shoveled the material into plastic bags which were then (depending on concentration) either loaded into trucks for pit disposal or put in drums for retrievable storage. This kept dust down and minimized the spread of contamination. (SLIDE) For hard to reach places, a backhoe was used to load soil directly into plastic-lined dump trucks. Each bucketful could be monitored if necessary. Water spray from garden hoses was used to minimize dust. For the bulk of the soil removal, the ground was surveyed and any hot spots were removed by the above two methods. (SLIDE) A ripper on the back of a crawler tractor was used to loosen the soil. Laborers followed the ripper blades spraying the turning soil with water from garden hoses. A phoswich survey was then conducted to see if any hot spots had been uncovered that should be removed by other means. Soil was then sprayed with water and pushed into a stockpile. (SLIDE). Front-end loaders scooped the soil from the stockpile and loaded it into plastic-lined dump trucks. (SLIDE) Water spray was used during scooping and loading operations for dust suppression. Once a truck was loaded, the load was covered over with plastic and a top was tied down over the load. The truck was driven across a pad of sand (to help scrub soil from the tires), through the access gate, and was monitored (SLIDE) for contamination. After a satisfactory survey (SLIDE), the truck driver was given a slip of paper indicating load number and disposition at the waste disposal area (uranium and transuranic waste go into different pits). Trucks with loads of significant contamination or special loads (septic tanks) were escorted to the waste disposal area by a health physics surveyor in another vehicle, who was in radio contact with the driver and any necessary emergency services.

Health Physics and Environmental Control

Standard anticontamination clothing was used on operations. Portable air samplers surrounded the immediate work area to evaluate airborne exposure to workers. Nose swipes were taken from each worker at the end of the work day. The area was surrounded by a chain link fence for contamination and personnel control and safety. Hi-volume air samples ($\sim$1 m^3/min) were run just outside the work fence and were analyzed daily. Environmental air net sampling stations were established at the three closest business establishments. Filters were changed every two weeks and were analyzed radiochemically for the isotopes of interest.

Documentation and Decision Making

Most of the decision making on when decontamination was adequate or at as low as reasonably achievable(ALARA) levels was done on a judgment basis. A primary point is who makes the final decision. This must be agreed upon and documented well in advance of any decision making. In our case ERDA Headquarters delegated this authority to the Albuquerque Operations Office (ALO). ALO personnel made frequent visits, attended briefings and made the final decision when an area had been decontaminated to ALARA. For a brief reminder of what the ICRP recommends on dose limitation objectives, I have the next two SLIDES. To relate soil concentration to dose takes a pathway analysis. Fortunately, at that time Jack Healy at Los Alamos had proposed an interim limit for plutonium of 230 pCi/g in the top 0.1 cm which could give 1.5rem/yr to the lung or 1.5-3 rem/yr to the mineralized portion of the bone of the maximum individual. Thus we had a number to consider. To date no official national or international standards exist for plutonium in soil. The EPA has proposed "guidance" which is a de facto standard with which we are to "comply" but no official standards yet exist. All standards refer to surface soil---there is no guidance for contamination several feet deep---that is still an ALARA judgment. We felt that for unrestricted use and given the long half life of plutonium and the penchant of man to move soil or dig deeply in it, that if subsurface soil had enough contamination so that a reasonable surface area could become contaminated to levels near or just below Healy's recommendations if the soil were disturbed then that contamination should be removed.

I would like to take you through a set of slides, indicating how such a decision was made. The example area had been contaminated by activities associated with the building where chemical and metallurgical research on plutonium was conducted (Bldg. D) and by the effluent from a laundry for contaminated clothing (Bldg. D-2). In the excavated area, with two known exceptions, no phoswich detectable activity remained. We were below the depths of waste water pipes, building foundations, and utility lines. Excavations were in apparently undisturbed tuff (the soft volcanic rock underlying Los Alamos). Thus, discovery of significant pockets of contamination was unlikely. Notice on this slide that with the exception of two areas with phoswich detectable activity (at the end of former laundry drain pipes and in the former septic tank location), the maximum contamination is 120 pCi/g of gross-alpha activity. The unexcavated gullies draining this area still hae significant contamination. In the next iteration (SLIDE) the gullies have been excavated, and 0.6 m of soil of the western half of the previous excavation has been removed. A trench up to 2.7 m deep was excavated in this gully [point out maximum values]. Did this represent ALARA? The excavation is as we said before, below likely further surprises or pickets of contamination, and was 0.6 to 3.5 m below the original surface. The trench area was no longer accessible with heavy equipment due to terrain. The cost of removing more soil was ~$ 50/m^3.

One area was accessible that had contamination in the low hundreds of pCi/g of gross-alpha. Thus, it was decided to remove another 0.6 m in this area, which would cost $5000. If general concentrations did remain the same or dropped, the area would have been decontaminated to ALARA. The trench was backfilled for safety and further excavation was done resulting in the concentrations shown on this SLIDE. Note that the maximum concentration has dropped from 310 to 250 pCi/g and not as many values are in the hundreds of pCi/g. This was determined to be decontaminated to ALARA because no phoswich detectable activity remained the concentrations were with one exception, below our guideline value of 230 pCi/g, were in undisturbed tuff implying a low probability of further pockets of contamination, il below original land contours (we would restore the land to original contours), were in an area not likely to be disturbed by future activities, further excavation would not likely be worth the added cost, and it would be difficult to remove more soil safely. (SLIDE) In the unlikely event of future site development, excavation in the area would dilute residual contamination.

This discussion is an example of the iterative process in determining ALARA in one of the more difficult to assess areas. Thus we determined the isotope of concern, extent and magnitude of contamination, dollar costs to remove additional soil, and hazards to personnel and equipment in trying to remove the additional soil, and future land use concerns (where it is possible that there will be more restrictive standards, which may or may not include subsurface considerations). Having a disposal area with 12 km of the decontamination effort was certainly a factor in our deliberations. Had the area been further away. ALARA would have been different due to costs

The criteria relating concentration to dose were very important but we needed flexibility to judge ALARA and urge that guidance be truly guidance and not a legal mandate. I suspect decontamination of a contaminated lightly inhabited desert might be different than decontamination of a crowded urban setting. Distance and expense of transporting low-level waste is a prime consideration. What would be acceptable in one situation might not be in another and we owe those whom we serve some measure of fiscal responsibility in determining ALARA. The dose limits to humans (except in special cases) still follow Federal Radiation Council (FRC) guidance of 500 mrem/yr to the maximum individual and 170 mrem/yr to a suitable sample of the exposed population. This was reaffirmed in September 1979 by the Environmental Protection Agency which has jurisdiction over the FRC.

When all is said and done, who's to say what's been done is sufficient in light of new knowledge some 20 years hence? Should further decontamination be considered necessary, it is a <u>must</u> that documentation of the as-left conditions be very thorough and accurate. Such documentation by those who went before would have certainly eased our job. We made a thorough phoswich survey to insure no hot spots remained; we took detailed grids of soil samples and reported <u>all</u> results. Grid corners were marked accurately by surveyors. Contours of the final contamination depths and locations were also surveyed before backfill operations started. It was fairly easy to do such documentation because we had bi-weekly reports and briefings to inform management and interested parties. Thus we were compelled to keep notes and data summaries up-to-date which meant data did not get overlooked or confused because of a long time between data collection and analysis. Liberal use of photography also documented our progress. Ample time must be allotted for the final report.

The project of moving 15,000 m^3 of contaminated debris and soil as well as doing environmental surveys, health physics, documentation and reporting involved manpower and money. Because the dollar is not constant, I'll merely show time and equipment costs in these last SLIDES.

Keep in mind what I've presented represents one part of a major effort in soil decontamination at Los Alamos, but it is representative of our approach to decontamination. Since TA-1 we've removed contaminated industrial waste line in the Los Alamos townsite, dismantled a plutonium incineration facility, dismantled a filter building contaminated with ^{227}Ac, are decontaminating the former plutonium handling facility, and have surveyed canyons and an old firing site contaminated with ^{90}Sr.

REFERENCES

1. A John Ahlquist, Alan K. Stoker, Linda K. Trocki, "Radiological Survey and Decontamination of the Former Main Technical Area (TA-1) at Los Alamos, New Mexico," Report LA-6887 (Dec. 1977).
2. A. John Ahlquist, C. John Umbarger, Alan K. Stoker, "Recent Developments for Field Monitoring of Alpha-Emitting Contaminates in the Environment," Health Physics 34, May 1978, p. 486-489.
3. J. W. Healy, "A Proposed Interim Standard for Plutonium in Soils," Los Alamos Scientific Laboratory Report LA-5483-MS (January, 1974).